1.0 INTRODUCTION

This progress report updates the operation and maintenance (O&M) and performance evaluation of the Muscoy Operable Unit (OU) Interim Remedial Actions (IRAs) and covers the reporting period between September 1, 2005 and September 30, 2005. The Muscoy OU IRA is being operated to address identified groundwater impacts within the Muscoy OU, which, together with the Newmark OU and Source OU, constitute the Newmark Groundwater Contamination Superfund Site (Site) (Figure 1-1).

The Muscoy OU IRA system and associated systems provide groundwater extraction, conveyance to the 19^{th} Street Treatment Plant, granular activated carbon (GAC) treatment and chlorination at the 19th Street Treatment Plant, delivery of potable water to the City of San Bernardino Municipal Water Department (SBMWD, also referred to as the City) water distribution system, and delivery, as needed, to the San Bernardino Valley Municipal Water District (SBVMWD, also referred to as Muni) via the Encanto Park Booster Pump Station (EPBPS).

This progress report has been prepared following the performance criteria requirements stipulated in the Consent Decree/Statement of Work (CD/SOW) between the United States Environmental Protection Agency (EPA) and SBMWD, dated March 23, 2005. Groundwater treatment system and extraction wellhead facilities have been installed in the Newmark and Muscoy OUs and are currently operating as follows, as required by the CD/SOW; the Source OU, added to investigate the source areas for the Newmark and Muscoy OUs, is not a part of the CD between EPA and SBMWD.

- The Newmark OU was established as "operational and functional" (O&F) on October 1, 2000, after a one-year performance evaluation period performed by EPA. EPA transferred O&M of the system to SBMWD following entry of the CD (March 23, 2005). SBMWD is currently operating the Newmark system and preparing monthly reports to document the system's ongoing operation and performance.
- The Muscoy OU underwent its one-year performance evaluation by EPA, beginning on July 25, 2005. URS Group, Inc. (URS) prepares monthly progress reports to document the system's O&M and performance. All analytical data collected will be included in the Semiannual Data Evaluation Summary Report (to be completed after each 6-month period during the first year of system operations). URS prepares these monthly reports and other reports on behalf of EPA, under the Response Action Contract (RAC) with CH2M HILL, Work Assignment 069. EPA will transfer O&M of the system to SBMWD after the system is declared O&F.

This progress report is organized as follows.

Section 1.0 provides an introduction.

Section 2.0 presents general project background information.

Section 3.0 presents the Progress Report objectives.

Section 4.0 presents methodologies.

Section 5.0 presents monthly results.

Section 6.0 presents conclusions and recommendations.

Section 7.0 presents activities planned for the next monitoring period.

Section 8.0 lists references cited or used in preparing the Progress Report.

Tables, figures, and appendices are provided at the end of the Progress Report.

2.0 PROJECT BACKGROUND

During a groundwater investigation in 1980, the California Department of Health Services (DHS) discovered chlorinated solvents in municipal supply wells within the northern San Bernardino/Muscoy region of San Bernardino. Several investigations were conducted to locate the potential source(s) of contamination. On March 30, 1989, EPA placed this region on the National Priorities List, thereby releasing federal funds for cleanup of the region, now identified as the Newmark Groundwater Contamination Superfund Site.

EPA initiated the Remedial Investigation/Feasibility Study (RI/FS) process for the Site in 1990, focusing on the Newmark plume. Subsequent investigations indicated that the area contained a second groundwater contamination plume, referred to as the Muscoy plume. Further investigation indicated that both plumes appear to emanate from the same area northwest of the Shandin Hills, suggesting that contaminants contributing to the Newmark and Muscoy plumes may have originated from the same source. In 1992, EPA expanded the Site RI to include the Muscoy plume after concluding that the two plumes probably originated from the same source area. A separate OU was designated for each of the plumes, namely, the Newmark OU (OU1) and the Muscoy OU (OU2). The Source OU (OU3) was added in 1993 as a means to investigate the suspected source areas for both plumes. The Site and its three OUs are shown on Figure 1-1.

An RI and an FS were performed for the site between 1989 and 1994. Two Interim Records of Decision (IRODs) were issued, one for the Newmark OU in 1993 and the other for the Muscoy OU in 1995.

The principal contaminants identified in site investigations were trichloroethene (TCE) and tetrachloroethene (PCE). Reported concentrations of these contaminants exceeded federal and California maximum contaminant levels (MCLs) for drinking water in several municipal wells within the San Bernardino and Muscoy areas, including the Newmark municipal well field.

As a result of the Newmark and Muscoy OU IRODs, groundwater treatment systems and extraction wellhead facilities were installed in the two OUs and are currently operating. Table 2-1 provides the timeline for the Newmark OU and the Muscoy OU Remedial Design (RD) and Remedial Action (RA). After the CD was entered on March 23, 2005, the Newmark OU treatment system was transferred to SBMWD for O&M.

2.1 Site Hydrogeology

This section summarizes the geographical and hydrogeological setting and local hydrogeologic conditions of the Site; it also explains the differences between the Muscoy and Newmark OUs as they relate to system performance evaluation.

2.1.1 Site Setting and Regional Hydrogeology

The Site is within the northern and central portions of the San Bernardino Valley (Figure 2-1). The wedge-shaped San Bernardino Valley opens to the southeast and is bounded by the San Gabriel Mountains to the northwest, the San Bernardino Mountains to the east and northeast, the Crafton Hills and San Jacinto Mountains to the southeast, and the Rialto Bench and Fontana plain to the west. Also bounding the valley are the sub-parallel, northwest-southeast-oriented San Jacinto and San Andreas faults.

Bedrock in the surrounding highlands and beneath the valley floor is composed of pre-Tertiary igneous and metamorphic rocks.

Quaternary age alluvial fan deposits derived from the San Gabriel Mountains to the northwest and the San Bernardino Mountains to the northeast fill the valley (Dutcher and Garrett, 1963). They consist of boulders, gravel, sand, silt and clay and range in documented thickness from 400 feet near the San Bernardino Mountains in the north to depths greater than 1,500 feet north of the Loma Linda/San Jacinto fault zone, near the center of the valley (based on borehole drilling for EW-111). Bedrock outcrops form numerous hills throughout the Site (including the Shandin Hills). Several faults and groundwater barriers have been identified in the alluvium throughout the Bunker Hill Groundwater Basin (Dutcher and Garrett, 1963). The alluvium forms a semi-confined aquifer system that is recharged primarily by infiltration along the northern extent of the basin and from the Santa Ana River. Groundwater flows generally toward the south.

2.1.2 Muscoy Area Hydrogeology

The northern portion of the alluvial unit within the Site consists predominantly of sand, gravel, and boulders with little or no clay. Clay lenses increase in number and thickness toward the central and southern portions of the valley, dividing the aquifer into several units. The largest and most influential units identified in the Newmark OU have been termed the Upper Water-Bearing Member and the Lower Water-Bearing Member (URS, 1996). Overlying zones of interfingered low-permeability silts and clays confine the Lower Water-Bearing Member in the vicinity of the Newmark plume front extraction well network. In the Muscoy OU, the stratigraphy is more variable, consisting of multiple sand and gravel water-bearing units, segregated by semi-continuous, low-permeability silts and clays.

At least two separate aquifers, referred to as the shallow and deep aquifers in this report, are present in the Muscoy area. These zones also are termed the upper and lower water-bearing members (Danskin et al., 1997). They are separated by an aquitard, or middle confining member, composed primarily of clay and silty clay. This layer is approximately 25 to 75 feet thick and typically is encountered at depths of 400 to 550 feet below ground surface (bgs) in the Muscoy area.

The shallow aquifer may range from confined to unconfined in this area, with a base elevation of approximately 600 to 700 feet above mean sea level (msl), which is equivalent to depths of approximately 400 to 500 feet bgs. The shallow aquifer in the Muscoy area varies in thickness from approximately 250 to 300 feet. Groundwater in this unit generally is encountered between 140 and 240 feet bgs.

The deeper aquifer appears to be fully confined, and it may consist of two or more sub-units, given the decreasing water levels at increasing depths. This unit generally is encountered south of the Shandin Hills, between 400 and 1,100 feet bgs. Deep aquifer groundwater in the Muscoy area was measured at depths of approximately 190 to 314 feet bgs in the year preceding extraction system startup. Water levels in the older, upgradient monitoring wells have decreased, in general, by 50 to 100 feet over the last decade. Water-bearing strata in the deeper unit are separated vertically by laterally discontinuous, lower-permeability silt and clay layers.

2.1.3 Hydrostratigraphic Zones

Well screen intervals were matched with hydrostratigraphic zones based on measured water levels, responses to pumping during the Muscoy startup, and the conceptual hydrogeologic model. These zones are independent of the labeled screen intervals (A, B, C, etc.), which merely denote relative screen depths at each well location and not the intercepted hydrostratigraphic units. As discussed, the shallow and deep aquifers are separated by an interval of clay and silty clay at a depth of approximately 500 feet in the Muscoy area. Numerous lenses of low permeability materials at varying depths above and below this unit are present in the Muscoy area (URS, 2006a), though they generally are absent in the Newmark area.

The deep aquifer may consist of two or more subunits, given the decreasing water levels at increasing depths. Lenses of fine material, combined with deep pumping from regional water supply wells, is the likely cause of the significantly lower water levels generally found at greater depths and of the large water-level fluctuations observed, especially in some deeper screen intervals.

The contaminant distribution in the Muscoy area was further characterized by depth-discrete zone sampling of the extraction wells in October 2005. Groundwater contamination in the Muscoy area is present in the shallow aquifer (hydrostratigraphic zone 1) and in the upper portion of the deep aquifer, termed the intermediate zone (hydrostratigraphic zone 2, roughly the top 200 feet of the deep aquifer). No contamination was found in the lower portion of the deep aquifer (hydrostratigraphic zone 3) in the Muscoy area. This contaminant distribution contrasts with the Newmark area, where most contamination is present lower in the deep aquifer.

Designated hydrostratigraphic zones selected during meetings between Secor International Inc. (Secor), on behalf of SBMWD, and URS are listed in Tables 2-2, 2-3, and 2-4. Hydrostratigraphic zones 1 and 2 are thought to best represent the shallow aquifer and the intermediate zone, respectively, based on water levels from long-term monitoring sampling events, water levels from the remote telemetry unit (RTU)/supervisory control and data acquisition (SCADA) system, pumping responses during the Muscoy startup, and lithologic and geophysical information from well logs. Hydrostratigraphic zone 3 represents the deep portion of the deep aquifer that supplies the Newmark extraction wells. Other hydrostratigraphic units were interpreted roughly, based on relative water levels. Assignment of these zones is interpretive and may change if new data appear to warrant it. No claim is made that the intermediate zone is precisely defined or hydrostratigraphically distinct from deeper strata.

Hydrostratigraphic zones were used to construct the plume maps using the November 2005 data. This discussion is provided in the *Semiannual Data Evaluation Summary Report* (URS, 2006a). These plume maps are used in the capture analysis described in Section 3.2.2 in this monthly report.

2.1.4 Extraction and Monitoring Well Completion

Well construction details are shown in Tables 2-2 (extraction wells) and 2-3 (monitoring wells).

2.2 Facilities Description

This section provides a brief description of the Newmark and Muscoy OU facilities, as constructed, and of Site-wide monitoring facilities.

2.2.1 Existing Facilities

2.2.1.1 Newmark OU Facilities

Construction of the Newmark OU extraction systems was completed in 1998. The treatment system was declared to be O&F on October 1, 2000.

The extraction and treatment system consists of eight extraction wells split into two separate extraction well networks. The Newmark north extraction well network consists of two EPA-installed extraction wells (EW-006 and EW-007) and one existing SBMWD production well (Newmark 3). The purpose of this extraction well network, located in the northwestern portion of the Newmark OU plume, is to inhibit further downgradient migration of contaminated groundwater along the northern side of the Shandin Hills, through a narrow gap between bedrock outcroppings and the San Andreas fault. Extracted groundwater is treated using seven pairs of 20,000-pound GAC vessels referred to as the Newmark North Treatment Plant.

Each pair of GAC vessels is operated in a lead-lag series configuration. The Newmark north facilities also include five monitoring well clusters (MW-4A/B, MW-7A/B, MW-9A/B, MW-16A/B, and MW-17A/B) used to monitor water levels and volatile organic compounds (VOCs) to evaluate the effectiveness of the Newmark north extraction well network.

The remaining five Newmark OU extraction wells, referred to as the Newmark plume front extraction well network (EW-001, EW-002, EW-003, EW-004, and EW-005), are along the leading edge of the Newmark plume; their purpose is to protect uncontaminated portions of the aquifer (Figure 1-1). Extracted water from EW-002, EW-004, and EW-005 is being treated using eight pairs of 20,000-pound GAC vessels at the Waterman Treatment Plant.

Extracted water from EW-003 is being treated using three pairs of 20,000-pound GAC vessels at the 17th Street Treatment Plant. Extracted water from EW-001, which was initially treated at the Waterman Treatment Plant, is now being treated at the 19th Street Treatment Plant. Each pair of GAC vessels is operated in a lead-lag series configuration. The Newmark plume front facilities also include six monitoring well clusters (MW-10A/B, MW-11A/B/C, MW12A/B, MW-13A/B/C, MW-14A/B, and MW-15A/B) that are used to monitor water levels and VOCs to evaluate the effectiveness of the Newmark plume front extraction well network.

2.2.1.2 Site-Wide Facilities

Site-wide monitoring wells are included as part of IRA operations to provide additional Site-wide groundwater-level monitoring and sampling facilities. Data from Site-wide monitoring wells are used to aid in evaluating the combined effectiveness of the Newmark and Muscoy OU extraction networks, to provide Site-wide background groundwater elevations, and to evaluate Site-wide contamination. The 23 Site-wide monitoring wells are shown on Figure 1-1. Site-wide sampling was conducted twice during the Muscoy one-year performance evaluation period; it will be conducted annually thereafter.

2.2.2 Construction of Muscoy OU Facilities

The Muscoy OU treatment system consists of five extraction wells; five monitoring wells downgradient from, and four monitoring wells upgradient from, the extraction wells; a booster station allowing delivery of treated water to Muni; a treatment plant with GAC vessels to treat contaminated water; and a system of pipelines connecting the extraction wells to the GAC treatment plant delivering raw water to be treated. The entire system was integrated into a SCADA system for automatic data collection of water level, extraction well flow, and treatment plant operational data.

The Muscoy OU system construction was performed in stages: two extraction wells (EW-108 and EW-112) were completed in 2002 with a portion of the pipeline, followed by the five downgradient monitoring wells in 2003. The last stage, completed in March 2005, included construction of the remaining three extraction wells (EW-109, EW-110, and EW-111), the GAC treatment plant at 19th

Street, the remaining portion of the pipeline with the Interstate 215 and Burlington Northern and Santa Fe (BNSF) Railroad undercrossing, and the EPBPS.

Shake down and startup took place between March and July 2005. The one-year performance evaluation monitoring began on July 25, 2005.

SBMWD subcontracted the installation of the five extraction wells to capture contaminated groundwater. Table 2-2 provides the final as-built well construction information and the pump size and well design flow rates for the Muscoy extraction wells. Data from pumping tests presented in the first *Semiannual Data Evaluation Summary Report* (URS, 2006a) show that all well completions are extracting water, except for the shallow zone of EW-108.

Extracted water from the five Muscoy OU extraction wells, along with water extracted from EW-001, is treated at the 19th Street Treatment Plant. Pipelines connect the extraction wells to the treatment plant at 19th Street and deliver raw water to the plant for treatment. The five monitoring wells are located south of (downgradient from) the extraction wells; monitoring of these wells provides information to evaluate the performance of the extraction wells system.

The new 19th Street Treatment Plant was constructed just north of the pre-existing 19th Street Treatment Plant and includes 12 new pairs of GAC vessels. The 24 new GAC vessels each hold 30,000 pounds of GAC. Each pair of GAC vessels is operated in a lead-lag series configuration. A new chlorine injection system and an expanded SCADA system were installed. After treatment at the 19th Street Treatment Plant, treated water is delivered into SBMWD's existing water distribution system and can then be routed to the EPBPS to be used by Muni.

The EPBPS is located between North Mt. Vernon and L Streets, near West 19th Street, in Encanto Park. The pump station consists of three vertical turbine can-type pumps with installed underground pipe and an installed spare pump barrel for a future additional pump, if necessary. Two of the pumps are designated for constant duty while the third pump is for standby use. During continuous operations, the pumps are rotated monthly to balance run-time. The booster pump station also consists of the pump motor control center, a pressure surge relief system, SCADA and radio telemetry system, and circuit breakers for the lighting and receptacles.

The 19th Street Treatment Plant, EPBPS, and the wells are monitored by SBMWD's SCADA system, which provides process data for the various systems. The SCADA system uses RTUs, radio modems, and various instrumentation to collect, store, control, and communicate process data to SBMWD's central operations office. Various data are collected from each system, including extraction well and system flow rates, GAC vessel influent header pressure, differential pressure across each GAC vessel, and water levels of monitoring wells.

At the end of construction, all systems were inspected and accepted by EPA, URS, and SBMWD. Exceptions noted during each final inspection were listed in Attachment A to each inspection list (provided in Appendix A) and subsequently addressed.

The system shakedown period began March 14, 2005, and was completed on May 17, 2005. The extraction wells were then brought online, one well per week, during the startup period. The one-year performance evaluation period began on July 25, 2005. The Muscoy system will be transferred to SBMWD once it is declared to be O&F, according to the performance criteria set out in the CD/SOW.

3.0 PROGRESS REPORT OBJECTIVES

This report is one of 12 scheduled monthly Progress Reports documenting data obtained during the previous month and assessing the effectiveness of the Muscoy OU remedial system through an annual hydrologic cycle, from August 2005 through July 2006. All operations, maintenance, and monitoring data described in these 12 Progress Reports will be analyzed to evaluate the operation and performance of the Muscoy OU RA and to support the determination of system O&F, based on the criteria established in the CD/SOW. The system will not be declared O&F until the end of the one-year performance monitoring period, which started on July 25, 2005, and/or until the system is demonstrated to be O&F. The purpose of this particular monthly report is to document and analyze the operations, maintenance, and monitoring data collected for the Muscoy OU during September 2005.

There are three primary sets of O&M data:

- A monthly inspection of the entire system, which includes both physical inspection and operating data;
- Water-level data, compiled by using the SCADA system or manually collected; and
- Chemical monitoring at the treatment plant, extraction wells, and monitoring wells for the Muscoy OU. Twice during this one-year period (November 2005 and May 2006), the Muscoy Sampling Program is to be performed concurrently with the Semiannual Site-Wide Sampling Program. The methodology for evaluating the system is described in more detail in Section 4.0.

The first six monthly Progress Reports include the results of all three sets of data, will be synthesized and discussed in the first Semiannual Data Evaluation Summary Report. In addition, the first semiannual report is to include the results of all tests or monitoring performed on the Muscoy system during shakedown and startup periods. After 6 months, monitoring well chemical data are to be collected only quarterly, and these two sets of quarterly monitoring well data are to be included in the second Semiannual Data Evaluation Summary Report. The semiannual reports are to include the corresponding Semiannual Site-Wide Sampling Program results, and the results of any other tests performed during the corresponding 6-month period.

The schedule of data collection and reporting requirements is provided in Table 3-1. All sampling, reporting, and other activities also are summarized and tracked in Table 3-1, with dates for submittals and expected due dates. All data collected and results obtained during each reporting period are to be included in the respective reports.

3.1 Operational Evaluation

The operational evaluation includes a monthly inspection of how the system performs physically and functionally, compared to system design, and notes any problems that occurred or issues noted during that period. Operations data reported include an inspection checklist of the mechanical and electrical systems, extraction and flow rates, pump downtimes, monthly and cumulative flows, monthly and cumulative VOC mass removed, and other data or information as appropriate. SBMWD collects most of these data during each month; URS, SBMWD, and E2 Consulting (E2) perform the inspection each month for the previous month's operations.

Monitoring data collected for the operational evaluation include groundwater levels and laboratory analytical results for samples from monitoring wells and extraction wells and from the treatment plant. The Muscoy and Site-wide monitoring programs are detailed in the *Newmark Groundwater Contamination Superfund Site, Site-Wide Field Sampling Plan* (FSP) (URS, 2005a). Detailed monitoring methodology descriptions are available both in the FSP and the *Operational Sampling and Analysis Plan, (OSAP), Newmark and Muscoy Operable Unit Interim Remedial Actions* (Draft OSAP), (Secor International, Inc. [Secor], 2005).

3.2 Performance Evaluation

The performance evaluation criteria set forth in the CD/SOW include the following, which are further described hereafter.

- Flow Rate Performance Criterion: The system extraction flow rate will equal or exceed the target extraction rate (TER), currently equal to the maintenance-adjusted design extraction flow rate.
- Flow Performance Criterion: Extraction well flow rates will be maintained so that an inward gradient is maintained across the Muscoy plume extraction well network.
- Containment Level Performance Criterion: Containment performance evaluation will be based on sampling results for downgradient monitoring well clusters.

The analyses presented in this report are based partially on the results of earlier studies. Following are previous documents that were developed to address groundwater containment criteria for the Site:

- *Groundwater Containment Remedy Compliance Technical Memorandum, Newmark Operable Unit* (URS, 2002a);
- *Newmark Operable Unit Capture Analysis Technical Memorandum* (URS, 2002b);
- *Operational Sampling and Analysis Plan (OSAP), Newmark and Muscoy Operable Unit Interim Remedial Action,* Draft (Secor, 2005);
- *Muscoy Operable Unit Remedial Action Capture Zone Analysis Plan, Newmark Groundwater Contamination Superfund Site* (URS, 2003a);
- *2003 Pumping Tests Technical Memorandum for Extraction Wells EW-108 and EW-112, Newmark Groundwater Contamination Superfund Site* (URS, 2003b); and
- *2003 Pumping Tests Capture Analysis Technical Memorandum, Newmark Groundwater Contamination Superfund Site* (URS, 2004).

The first three documents apply to the Newmark OU and address monitoring methodologies (Secor, 2005), compliance criteria (URS, 2002a), and the results of a capture analysis using the July 2002 groundwater monitoring data (URS, 2002b). The fourth document provides the plan for a capture analysis of the Muscoy plume. The last two documents present the results of capture analyses for extraction wells EW-108 and EW-112 and their application to capture analysis based on that plan.

3.2.1 Flow Rate Performance

Compliance with flow rate performance criteria is evaluated by comparing the monthly average flow rate of the system (total of all Muscoy extraction wells) in gallons per minute (gpm) to the established TER (in gpm). Currently, the TER is equal to the maintenance-adjusted design extraction flow rate (allows for 35 days of maintenance per year) in gpm. The design flow rate is the sum of the five individual extraction wells' design flow rates. The maintenance-adjusted design extraction flow rate is 8,046 gpm. If the average system flow rate during the month equals or exceeds 8,046 gpm, the flow rate performance criterion is met. The CD/SOW allows for reducing the TER if certain capture criteria are met, with lead oversight agency approval.

3.2.2 Flow Performance

Flow performance criteria have been established in the SOW to evaluate the degree of upgradient capture achieved by the Muscoy plume extraction well network. The percent of upgradient capture will be estimated based on water-level data collected from wells specified in the SOW. Water-level data will be used to estimate the potentiometric surface of the contaminated water-bearing member and, subsequently, to perform particle-tracking analysis. No changes in system operations are planned during the first 6 months of operation. Changes may be instituted after 6 months, based on the capture zone evaluation.

3.2.3 Contaminant Performance

Contaminant performance for the Muscoy OU IRA is based on evaluating reported VOC concentrations for groundwater samples collected from monitoring wells downgradient from the Muscoy plume front extraction well network (MW-135, MW-136, MW-137, MW-138, and MW-139). Given the pre-existing contamination in the Muscoy OU, specific contaminant performance criteria were developed to evaluate the Muscoy contaminant concentrations during the one-year performance evaluation period. As provided in the CD/SOW, in Section a)i) under Contaminant Level Performance Criteria, the Muscoy contaminant performance criterion for the performance evaluation period is to suspend from evaluation any monitoring wells with PCE or TCE concentrations above 1 part per billion (ppb) (1 microgram per liter [µg/L]). These wells will be excluded from routine O&M performance criteria until detected concentrations of this compound decrease below 1 µg/L for eight consecutive quarters.

4.0 METHODOLOGY

This section presents the methodology to document and analyze the operations, maintenance, and monitoring data collected for the Muscoy OU for a monthly reporting period. Monthly data analysis consists of an operational evaluation and a performance evaluation, as described hereafter.

The responsibility for operational monitoring is shared by URS and SBMWD. URS inspects the physical system monthly and collects water samples from the treatment plant, extraction wells, and monitoring wells; these samples are analyzed by the EPA Region 9 Laboratory. SBMWD monitors water-level data using its SCADA system and all functional operating data for the treatment plant and extraction wells. The performance evaluation, performed by URS, involves comparing monthly extraction flow rates to design rates, evaluating contaminant concentrations and developing plume isocontour maps, and performing capture analysis, using water-level data, to determine flow performance. Detailed descriptions of how monthly extraction rates and water levels are determined and chemical monitoring methodologies can be found in the Draft OSAP (Secor, 2005)

4.1 Operations Evaluation Methodology

This section summarizes the methodology used to evaluate the Muscoy system operations.

4.1.1 Monthly Inspection

The operating evaluation includes a monthly inspection of mechanical and electrical system performance. The inspection for each monthly period is performed in the following month. The monthly inspections and evaluations, which began after the treatment plant startup period, are performed to confirm that the system is operating as designed. A team consisting of members from URS, SBMWD, and E2 conducts a monthly performance evaluation of each system component, including the 19th Street Treatment Plant and EPBPS systems, the extraction and monitoring wells, and the pipeline. Any problems or unexpected maintenance items encountered from the past month are noted and discussed, and equipment inspections are performed as needed. At the end of the monthly inspection, the members of the inspection team sign off a monthly inspection checklist for the mechanical, electrical, and SCADA operations of each component.

SBMWD provides treatment plant and extraction well data, including maintenance performed, flow rates, run times, and analytical results, in tabular format monthly.

4.1.2 Water-Level Measurement

Data from pressure transducers present in the Muscoy monitoring and extraction wells are logged in the RTUs of the SCADA system. RTU data are converted to usable groundwater elevation data (by SBMWD) for analysis by URS. Wells equipped with pressure transducers are monitored at a minimum frequency at least equal to the one provided in Table 4-1, though most of these wells are monitored hourly. A detailed description is included in the Draft OSAP (Secor, 2005).

Additional manually collected water levels are obtained using a water-level sounder and are used, when appropriate, to augment transducer data. The water levels are used to prepare groundwater elevation contour maps.

4.1.3 Chemical Monitoring Methodology

Samples are collected monthly and quarterly from the extraction and monitoring wells in order to help evaluate Muscoy plume extraction system performance. Detailed sampling and analysis methodologies are included in the Draft OSAP (Secor, 2005) and the Side-Wide FSP (URS, 2005a). Details of the Muscoy performance evaluation monitoring program, including the list of wells sampled in the Muscoy sampling program, are summarized in Table 4-2. The schedule of sampling events is included in Table 3-1.

In addition to the Muscoy OU extraction and monitoring well sampling, long-term monitoring program (LTMP) samples are collected from Newmark and Muscoy extraction wells semiannually. Sampling under the LTMP is performed using passive diffusion bags (PDBs). Details of the sampling programs, procedures, and sample handling are specified in the Site-Wide FSP (URS, 2005a).

The semiannual LTMP samples were collected in November 2005 and in May 2006. During these two events, the Muscoy OU sampling program was performed concurrently with the LTMP to avoid duplication of effort in the common locations.

4.1.3.1 Treatment Plant Sampling

Once per month, for the one-year performance evaluation period, samples are collected from the treatment plant. In addition to treatment plant effluent sampling, one carbon vessel pair is sampled each month. Each vessel pair will have been sampled once by the end of the performance evaluation period. The samples are collected from the treatment plant effluent and carbon vessel sample ports (vessel A influent, vessel A effluent, and vessel B effluent).

4.1.3.2 Extraction Well Sampling

Once per month for the first 6 months of the one-year performance evaluation period, and quarterly thereafter, samples are collected from the extraction wells and the extraction well piezometers. Samples from the extraction wells are collected from sample ports at the wellheads. Samples from the piezometers are collected using bailers or PDBs.

Three depth-specific zone sampling events were performed on extraction wells (in January 2006, April 2006, and July 2006). This data was utilized to help interpret vertical contaminant distribution.

4.1.3.3 Monitoring Well Sampling

Once per month for the first 6 months of the one-year performance evaluation period and quarterly thereafter, samples are collected from the monitoring wells using PDBs.

LTMP samples are collected from Source OU, Newmark OU, and Muscoy OU site-wide monitoring wells semiannually.

4.1.3.4 Laboratory Analysis

All samples are sent to the EPA Region 9 laboratory for analysis for VOCs. The analytical requirements, quality assurance/quality control (QA/QC) protocols, and validation requirements are described in the Site-Wide FSP (URS, 2005a) and *Newmark Groundwater Contamination Superfund Site Quality Assurance Project Plan* (QAPP) (URS, 2005b). The sample turnaround time is 30 days.

4.2 Performance Evaluation Methodology

This section summarizes the methodology used to evaluate the Muscoy system performance. The details of the methodology, and a discussion of its limitations and uncertainties, will be presented in the Semiannual Data Evaluation Summary Report.

4.2.1 Flow Rate Performance Methodology

Flow rate performance criteria have been established in the CD/SOW. Compliance with flow rate performance is evaluated by comparing the monthly average flow rate (total flow from EW-108, EW-109, EW-110, EW-111, and EW-112), provided by SBMWD, to the established TER. The TER is currently the maintenance-adjusted design extraction rate (8,046 gpm), which adjusts the system design flow rates to allow for scheduled and unscheduled maintenance of the extraction and treatment facilities. The maintenance allowance is for up to a total of 35 days of maintenance shutdowns per year. The maintenance allowance is applied on a 3-month rolling average basis; therefore, the design flow rate for the Muscoy extraction well network is adjusted downward for the equivalent of 8.75 days of maintenance over the 3-month period.

4.2.2 Flow Performance Methodology

Flow performance criteria have been established in the CD/SOW to evaluate the degree of upgradient capture achieved by the Muscoy plume extraction well network. The flow performance is evaluated in the first year to establish that the system captures the contamination upgradient from the Muscoy extraction wells.

Remedial monitoring programs are designed to measure the effectiveness and efficiency of an extraction system in achieving hydraulic containment objectives. The success of hydraulic containment depends on groundwater contaminants following pathlines that terminate at the extraction system (Cohen et al., 1994). Hydraulic capture analysis consists of the generation of plume maps, potentiometric (water-level) contour maps, and contaminant pathlines.

The contamination plume extent used in the current monthly capture analysis was developed in the Semiannual Data Evaluation Summary Report (URS, 2006a). Contaminant plume maps were developed for the shallow and intermediate zones based on the methodology outlined in the Draft OSAP (Secor, 2005), using the November 2005 groundwater sampling results. The November 2005 data set is the most comprehensive data set because it includes samples from additional wells. Plume maps are prepared using groundwater analytical results for samples collected from monitoring wells with short screens, discrete groundwater samples collected from extraction wells, and several production wells with long screens. Samples from long-screened wells are given less weight in the drawing of the contours because they represent concentrations mixed over the screened interval. Given the sparse data for areas east and southeast of the Muscoy extraction wells, uncertainty of the plume extent in this area is greater. Also, the distribution of the contaminants in the aquifer can be non-uniform, resulting in temporal changes in contaminant concentrations at monitoring wells. Temporal variations in well concentrations also can be caused by changes in groundwater flow directions. These uncertainties are discussed in the contaminant performance assessment in the first Semiannual Data Evaluation Summary Report (URS, 2006a).

Water levels provided by SBMWD and additional water-level data provided by URS and the United States Geological Survey (USGS) are used to prepare groundwater elevation contour maps for the current month. Particle flow lines, based on potentiometric contours, are used for performance assessment. Water levels measured in some extraction wells are corrected for well losses before contouring. These corrections and the selection of wells representative of the shallow and intermediate water-bearing zones will be discussed in the Semiannual Data Evaluation Summary Report.

Water levels were contoured using Tecplot® (version 10) by Amtec Engineering, Inc. (Amtec, 2003). This software application can generate contours and calculate flowlines based on that surface. The contours were prepared by interpolating the measured water levels onto a triangular mesh.

Kriging was used to interpolate the water levels. However, because the size of the Muscoy water-level data set is not sufficient for estimating a sample semi-variogram, kriging is not used in a geostatistical sense. The generated contours are interpretive and based on professional judgment.

Capture analysis is performed for the shallow aquifer plume and the intermediate zone. Flowlines are generated by downhill tracking of a particle over the interpolated surface from a chosen starting point. A total of 40 particles are placed along a transect across the 2.5 µg/L Muscoy OU plume contour, north of the extraction barrier formed by the five extraction wells. Particle pathlines terminating in an extraction well represent capture; pathlines bypassing the extraction wells indicate incomplete capture. Figures 4-1 and 4-2 show capture analysis for the shallow aquifer plume and the intermediate zone, respectively, for the current monthly reporting period. The results for the current reporting period are discussed in Section 5.0.

4.2.3 Contaminant Performance Methodology

Contaminant performance for the Muscoy OU IRA is based on evaluating concentrations of contaminants of concern (COCs) in groundwater samples collected from monitoring wells located downgradient from the Muscoy plume front extraction well network (MW-135, MW-136, MW-137, MW-138, and MW-139), for comparison with the 1 ppb trigger level defined in the CD. The contaminant performance evaluation is intended to assess the ability of the extraction well network to maintain contaminant concentrations below trigger levels of 1 ppb (1 µg/L) in the monitoring wells downgradient from the extraction wells.

Contaminant performance will be evaluated after 6 months, and the results will be included in the first Semiannual Data Evaluation Summary Report (URS, 2006a). The monthly reporting documented here is limited to the analytical results for groundwater samples.

5.0 MONTHLY RESULTS AND DISCUSSION

This section presents the results and discusses the analysis of the operations, maintenance, and monitoring data collected for the Muscoy OU for the monthly reporting period (September 2005). Monthly data analysis consists of an operational evaluation and a performance evaluation, as described hereafter.

5.1 Operational Evaluation Results

5.1.1 Monthly Inspection

URS, SBMWD, and E2 conducted the operational evaluation for the month of September on October 11, 2005. The Monthly Performance Inspection Checklist for September 2005 is included in Appendix B. A SCADA inventory and summary of operational issues are included in Appendix C.

A summary of the status of operational and construction issues for the 19th Street Treatment Plant is included in Table 5-1. A summary of the status of operational and construction issues for the EPBPS is included in Table 5-2. A summary of the status of operational and construction issues for the extraction wells and the monitoring wells are included in Table 5-3 and Table 5-4, respectively.

5.1.2 Treatment Plant Operations Data

SBMWD provides 19th Street Treatment Plant operations data monthly. Routine maintenance was performed at the 19th Street Plant during the reporting period. A description of routine maintenance performed, problems encountered, and process improvements implemented is provided in Table 5-5 for the 19th Street Treatment Plant.

During September 2005, 1,330.2 acre-feet of water were treated and 22.4 pounds of mass was removed at the 19th Street Treatment Plant. A summary of GAC treatment plant flow data and estimated mass removal of TCE and PCE is provided in Table 5-6. A copy of the SBMWD Monthly Summary Treatment Report for submittal to the California Department of Health Services as part of SBMWD's Water Supply Permit (DHS Report) for the reporting period is provided in Appendix D.

It should be noted that the Operations Monthly Treatment Report table included in the DHS Report (Appendix D), shows the monthly volume of water pumped through each of the GAC carbon vessel pairs. In the spreadsheet, all of the treated volume is attributed to the current lead GAC vessel for carbon loading tracking purposes. However, this same volume of water flows through the lag vessel, even though the volume is shown as zero in the spreadsheet.

5.1.3 Extraction Well Operations Data

SBMWD provides extraction well operations data (run-time and flow volume and rate data) for the Muscoy OU monthly. Routine maintenance checks were performed on the five extraction wells, EW-108 through EW-112. EW-110 operated at low flow rates. A summary of routine maintenance performed, problems encountered, and process improvements implemented is provided in Table 5-7. A plot of continuous extraction rate versus time for all wells is shown in Figure 5-1.

The Muscoy OU extraction wells had a combined average extraction rate of 8,531 gpm and produced 1,131.1 acre-feet in September 2005. A summary of extraction well flow data and well run-times for the reporting period is provided in Table 5-8. The two-month rolling average for the Muscoy OU wells was

8,460 gpm. The flow rate was greater than the TER (currently, the maintenance-adjusted design extraction flow rate) of 8,046 gpm, which allows for maintenance (8.75 days per quarter). A calculation of the rolling average extraction rate and comparison to SOW-stipulated extraction criteria for the Muscoy extraction well network is provided in Table 5-9.

5.1.4 Water-Level Monitoring Data

Transducer data for September 2005 were logged in the RTUs of the SCADA system. RTU data were converted to usable groundwater elevation data (by SBMWD) for analysis by URS. The data were provided to URS as groundwater elevations for the Newmark OU, the Muscoy OU, the Site-wide monitoring well system, and for any additional voluntarily monitored wells (Appendix E). A description of SBMWD's routine maintenance performed, problems encountered, process improvements implemented, and deviations from the operational requirements of the CD during the reporting period for Site-Wide monitoring data is provided in Table 5-10.

SCADA water-level data collected at noon on September 26, 2005, were selected to represent the potentiometric surface for September because additional manual data were collected on that day.

Table 5-11 presents groundwater-level data used to contour potentiometric surfaces in the shallow aquifer and intermediate zone for September 2005, along with other water-level data collected during that period.

Data were evaluated for accuracy and consistency. Hydrographs of groundwater elevations (Figures 5-2 and 5-3) reflect changes in pumping rates both within and outside the Muscoy system. Except for EW-110, pumping rates (Figure 5-1) were generally stable in the Muscoy extraction wells during September. The pump in EW-110 apparently cannot sustain the design extraction rate, so discharge from this well is always relatively unstable, with fluctuations typically between 2,100 and 2,400 gpm.

Brief pumping shutdowns typically occur in various extraction wells. These have only minor or short-lived effects on water levels. Noteworthy pumping fluctuations in September 2005 are described below.

- September 7-13: EW-2 shutdown numerous times during this period, sometimes for several days.
- September 19-21: Several pumping wells shutdown briefly between these dates. EW-112 was shutdown for this entire period.

Mean water levels in the Muscoy extraction well piezometers (and piezometers in EW-1 and EW-2) increased approximately 1.6 feet relative to contoured data from the previous month, while the mean level in monitoring wells decreased approximately 1.6 feet. The mean total discharge for the Muscoy extraction wells in the week preceding the contoured data was 8,200 gpm, which represents a decrease of 440 gpm from the pumping rate of 8,640 gpm for the week before data from the previous month. Changes in mean water levels likely reflect a combination of changes in on-site pumping, seasonal off-site pumping, and seasonal recharge to the aquifer, specific to each aquifer. Off-site pumping effects appeared to occur throughout the month based on cyclical water level fluctuations in some wells (e.g. MW-135B, MW-136C).

5.1.5 Treatment System Chemical Monitoring

The September Muscoy chemical sampling of the treatment plant was completed on September 30, 2005. The September Muscoy chemical sampling of the extraction and monitoring wells was completed from September 19 to September 21, 2005. Groundwater samples were collected by URS and shipped to the laboratory for analysis. Deployment of the PDBs for the October 2005 Muscoy performance samples was completed on September 21, 2005.

A summary of analytical results for groundwater samples collected from the extraction and monitoring wells during the reporting period is provided in Table 5-12. A summary of analytical results for the treatment plant influent, lead vessel effluent, and combined lag vessel effluent during the reporting period is provided in Table 5-13. No analytical monitoring is performed on the effluent of the EPBPS, with the exception of chlorine residuals, for which SBMWD routinely takes samples twice per day; these data have been provided to URS. Analytical results for the various components are described hereafter. In addition, plots of concentration versus time for the extraction wells, extraction well piezometers, and monitoring wells are provided in Appendix F.

PCE and TCE in the extraction wells and their associated piezometers ranged from less than 0.50 micrograms per liter (µg/L) (non-detect) to 14 µg/L and from less than 0.50 µg/L (non-detect) to 3.5 µg/L, respectively. PCE and TCE in the monitoring wells ranged from less than 0.50 µg/L (non-detect) to 9.8 µg/L and from less than 0.50 µg/L (non-detect) to 2.9 µg/L, respectively. PCE and TCE in the treatment plant influent were 5.2 µg/L and 1.0 µg/L, respectively. PCE and TCE effluent concentrations from both lead and combined lag vessels were below detection limits.

5.2 Performance Evaluation Results

A summary of compliance with performance criteria for the reporting period, as described in Section 3.2, is provided in Table 5-14.

5.2.1 Flow Rate Performance

The two-month rolling average for the Muscoy OU wells was 8,460 gpm (Table 5-9). This operating flow rate was greater than the TER (which is currently the maintenance-adjusted design extraction flow rate) of 8,046 gpm. The Muscoy OU extraction wells met the flow rate performance criteria as prescribed in the CD/SOW for the month of September 2005.

5.2.2 Flow Performance

The contoured potentiometric surface in September was very similar to the contoured surface in August. Based on contoured water level data from September 26, 2005, groundwater in the shallow aquifer generally flowed southeast in the Muscoy area at hydraulic gradients ranging from approximately 0.005 to 0.015 (Figure 4-1). Groundwater in the intermediate zone generally flowed east-southeast in the Muscoy area, at hydraulic gradients ranging from approximately 0.003 to 0.02 in September 2005 (Figure 4-2). Pumping from the Muscoy system influenced flow and gradients in both zones.

Based on hydraulic capture (streamline) analysis, 90% of upgradient groundwater (within the 2.5 µg/L plume contour) was captured in the shallow aquifer (Figure 4-1). There was a 10% loss of upgradient capture (four flowlines) on the east side of the shallow PCE plume in September. Complete (100%)

upgradient plume capture (within the 2.5-µg/L contour) was indicated for the intermediate zone (Figure 4-2). Capture was based in interpreted 2.5 µg/L and 5 µg/L PCE plume contours using November 2005 data.

Shallow Aquifer

Forty particles were placed across the 2.5-µg/L plume contour in the vicinity of MW-128, MW-129, and MW-130. Plume width at this location is approximately 5,300 feet. Four flowlines (10%) on the east side of the plume were not captured within this transect.

All captured particles flowed into EW-110, but not all capture occurred at this well. Particle tracking analysis will always result in particles traveling toward the lowest local point on the contoured potentiometric surface. Extraction wells with higher water levels may appear to have no capture, with this technique, if there is a lower point on the potentiometric surface nearby. However, a discharging well will always capture some groundwater. Although all Muscoy OU capture in the shallow zone appears to be achieved by EW-110, the other extraction wells (except EW-108) also contributed to the capture; their contribution, however, cannot be shown by particle tracking without additional water-level observations between the extraction wells. All production in EW-108 derives from the deep aquifer at depths below 510 feet; consequently, this well achieves little or no capture in the shallow aquifer.

Particles lost to capture on the east side appear to flow into EW-001 because of the low water level measured in the EW-001A piezometer. EW-001 is screened in the deep aquifer, and SBMWD maintains that there is little or no leakage into this well from the shallow aquifer, which means that the lost capture would flow through and past this well.

Intermediate Zone

Forty particles were placed across the 2.5-µg/L plume contour in the vicinity of MW-129. Plume width at this location is approximately 1,730 feet along this line. All flowlines across this transect were captured using September 2005 water-level data.

All intermediate zone particles flowed to EW-110; as with the shallow aquifer, this occurred because the water level in EW-110D was the lowest local point on the potentiometric surface.

5.2.3 Contaminant Performance

The groundwater sampling results are presented as concentration time-series in Appendix F. PCE and TCE semi-log concentration plots for well groups are presented in Appendix G. No significant changes in contaminant concentrations measured in samples from the monitoring wells were detected. A detailed analysis of the contaminant concentration data for all of the Muscoy wells will be performed as part of the Semiannual Data Evaluation Summary Report (URS, in preparation 2006). PCE concentrations in 22 wells and screen intervals exceeded 1 µg/L in September 2005 (Table 5-12), and TCE concentrations in eight wells/screen intervals exceeded 1 µg/L during this month.

6.0 CONCLUSIONS AND RECOMMENDATIONS

This section presents the conclusions and recommendations from the analysis of the operations, maintenance, and monitoring data collected for the Muscoy OU for the monthly reporting period of September 2005.

6.1 Conclusions

The assessment of the system operation and performance during September 2005 is presented in this section.

6.1.1 Operational Performance

The system was fully operational, with the exception of Attachment A items noted during component final inspections.

6.1.2 Treatment Plant and Well Monitoring

All routine data collection was performed. Additional water levels were measured manually.

6.1.3 Flow Rate Performance

The 3-month rolling average was greater than the TER.

6.1.4 Flow Performance

Based on hydraulic capture analysis, the Muscoy extraction system appeared to achieve 90% capture of upgradient groundwater with PCE concentrations greater than 2.5 µg/L in the shallow aquifer, and 100% upgradient capture in the intermediate zone in September 2005. September is typically a period of high pumping demand for this area.

The lack of valid shallow water-level data at EW-109 and EW-112, and the lack of usable groundwater data north of EW-108 and northwest of MW-129, decreases confidence in the results of the capture zone analysis.

The lack of additional monitoring wells south of existing monitoring wells prevents accurate assessment of the downgradient plume extent and capture. The lack of usable water-level and concentration data in MW-136A (screened too shallow) and in MW-135B (screened too deep) creates minor data gaps in the shallow aquifer and intermediate zone, respectively.

6.1.5 Contaminant Performance

No significant changes in measured contaminant concentrations were detected in samples from the monitoring wells. It is too early into the Muscoy system operation to expect observable concentration trends attributable to the extraction system. PCE concentrations in three downgradient compliance wells (MW-135A, MW-137A, and MW-138A) exceeded 1 µg/L in September 2005, as did TCE concentrations in one compliance well (MW-135A), as shown in Table 5-12.

6.2 Recommendations

The following actions are recommended to determine or to achieve performance criteria for the Muscoy OU.

Continue pumping the extraction system, at the design rate, and analyzing capture using water-level and sample data. Hydraulic and chemical data will be evaluated after the first 6 months of operation.

6.2.1 Operational Performance

Continue the current activity.

6.2.2 Treatment Plant and Well Monitoring

Additional manual water-level collection should continue to supplement the SCADA system data. Efforts should continue to acquire any additional static water levels that can be obtained.

6.2.3 Flow Rate Performance

Continue the current activity.

6.2.4 Flow Performance

Continue the current activity.

6.2.5 Contaminant Performance

Continue the current activity.

7.0 ACTIVITIES IN THE NEXT MONITORING PERIOD

The activities planned for the next month include routine monitoring, inspection, evaluation, and reporting, plus the additional manual water-level measurements recommended in Section 4.1.2.

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